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BEFORE THE ARIZONA CORPORATION COMMISSION

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TOM FORESE
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ANDY TOBIN
COMMISSIONER

IN THE MATTER OF THE COMMISSION'S EXAMINATION INTO THE MODERINZATION AND EXPANSION OF THE ARIZONA RENEWABLE ENERGY STANDARD AND TARIFF.	Docket No. E-00000Q-16-0289

RUCO's COMMENTS

The Residential Utility Consumer Officer ("RUCO") hereby provides the following comments to Chairman Little's September 14, 2016 letter.

1. Is a REST requirement of 30% by 2030 achievable and appropriate?

Please note that throughout this document and the attachment, RUCO's comments are only related to investor owned utilities.

RUCO absolutely believes that 30% by 2030 is achievable in the technical sense. In terms of appropriateness, it depends on policy objectives and the individual utility. There is value in diversifying generation resources especially given the current cost competitiveness of large scale renewables with traditional resources. There is not much of a direct economic tradeoff anymore in pursuing "must take renewable electrons." Although there are indirect costs to not matching that production to when the system needs those electrons. The next evolution in Arizona policy should be a leadership position in this regard. Reaching a 30% by

2030 is doable and appropriate from a fuel diversification standpoint but Arizona should start to think ahead and be bold.

There are two ways in which RUCO sees Arizona leading the country in thoughtful energy policy:

1. In the IRP process, set bold targets custom to each utility. This could include non-emission generation or non-fuel resource targets or it may very well be a retail sales based renewable energy target. The IRP process allows the Commission to tailor specific goals that take into account the uniqueness that each utility possesses in generation assets, ratepayers, etc.

2. Crafting a new more forward looking Renewable Energy Standard that addresses system cost drivers like peak demand. A retail sales-based standard is simple because it just focuses on energy but that simplicity comes with a price because it ignores capacity, an equally important energy service. This caused RUCO to think outside the energy-only construct and consider alternatives to the traditional REST, such as the concept introduced in the attached Whitepaper. RUCO proposes a new policy based on this concept that addresses demand-related system cost drivers while ensuring a sizable non-fuel based resource mix.

2. Should we encourage the adoption of storage and if so how? Should REST credit be provided for deployment of battery storage alternatives for both residential, utility-scale and community-scale solar?

Yes, RUCO strongly supports the adoption of cost effective energy storage. That said, RUCO believes in technology agnostic frameworks that utilize market principles. Sending capacity related price signals will facilitate storage and other peak demand reducing technologies. RUCO's White paper addresses this very topic. See Whitepaper attached as Exhibit 1.

3. Review the appropriateness of continuing the Renewable Energy Credits ("RECs") as currently constituted. Do we need RECs to assess compliance or is there a simpler/better way?

Renewable Energy Credits (RECs) are simple and effective for compliance. The complexity comes with having multiple carve outs which essentially create different categories of RECs. When REC exchange is tied to direct incentives like in Arizona, it can be especially complex. Currently Arizona has a strong rooftop solar market with no direct incentives. Therefore, the PV systems coming online do not count towards the REST and their environmental attributes (RECs) are likely held by out of state companies that can sell these unbundled RECs anywhere. For years, RUCO has advocated to just simply switch the REC exchange mechanism for these systems to something other than direct incentives. Waivers are temporary and bring uncertainty to stakeholders. It is not a fundamental issue with RECs, it is the design of policy and how it intersects with current economics.

4. Is the DG carve-out appropriate in light of current market conditions and levels of penetration?

Appropriateness of the DG carve-out is linked to the policy intent/problem it is designed to address. As mentioned below, reliability was a driver for the current DG carve-out. To that end, RUCO has not seen conclusive evidence that the 4.5% DG carve-out, consisting mostly of uncoordinated and "invisible" third party installs, greatly impacts the reliability of the system for the better. If local capacity in a load pocket is a concern, then it may be prudent to have a load pocket carve-out. But that is likely as granular as it can go before getting into very specific geo-targeting, coordinated installs, and controlled dispatch for T&D deferral use cases.

Current market conditions reflect the policies of today. Growth of rooftop solar has been detached from system need and the REST standard. It is a financially unsustainable situation especially in light of 3-4 cent/kWh utility scale solar PPAs. The correction to this situation, in RUCO's perspective, is not to kill rooftop solar, rather it is to rationalize the install rate and send price signals to encourage smarter deployments (both in location and technology coupling). RUCO is not convinced that the DG carve-out in its current form is needed to meet these two objectives.

5. Does the definition of DG need to change? Is the definition relevant if the carve out goes away?

Yes, the definition should be more broad. For instance residential customers that subscribe to a community solar program should count towards the residential carve-out. Not allowing this effectively institutionalizes economic disparity between those with homes and good roofs vs. everyone else. Again, if there is any carve-out it should be load pocket specific. Within the load pocket there would be no distinction between a residential rooftop vs a community solar array in a park.

Finally, if there is no carve-out, the definition would be irrelevant.

6. Is there a place for home energy management technologies in the REST? Should DG installations that also include home energy management technologies be given special consideration under the REST?

RUCO considers home energy management to be a broad category that encompasses many discrete types of technologies and capabilities. In theory, these technologies could provide beneficial grid services that enhance the value of any distributed renewable energy being generated. However, these technologies do not necessarily increase the overall quantity of renewable energy (in MWh) being provided. Thus, under the traditional REST framework special consideration may not be warranted. However, under an enhanced REST framework such as that outlined in the attached Whitepaper, there may be a role for home energy management to contribute to additional building blocks components pursued in conjunction with the traditional REST framework.

7. Would it be appropriate to consider REST credit for utility grid modernization investments designed to support emerging renewable technologies and higher DG penetrations in certain areas?

RUCO does not see a clean link or compliance method between the two. There are other avenues to encourage this type of investment. RUCO would be happy to have that discussion when the time is right.

8. Should we look at the Locational Marginal Price (LMP) for distributed solar in certain neighborhoods to drive adoption in places where the grid is better suited to higher DG penetrations? How would and/or should this concept be incorporated into the REST rules?

Absolutely, obtaining more locational pricing data and mapping the distribution system is a must as Arizona moves into a future of greater customer choice and more local resources. However, RUCO does not see a direct link to REST rules. The IRP, or eventually a DRP (distribution resource plan) as well as standalone targeted programs would likely be the most suitable venues.

The key to driving adoption in high value locations is the compensation mechanism used to DG adopters/developers. If behind the meter resources are chosen as a means to fulfill the REST, retail rate transactions are likely too cumbersome a compensation mechanism given that rate design is not location specific in Arizona. This is precisely why RUCO has advocated for transactions like the RPS Credit Option which was approved in UNS rate case. When compensation is separated from the retail rate it enables more flexibility, transparency, and control.

9. What REST standard should the cooperatives need to meet?

No comment - this goes beyond RUCO's statutorily defined mandate.

10. Is it important to have annual REST requirements in place or is establishing a requirement for the end date sufficient?

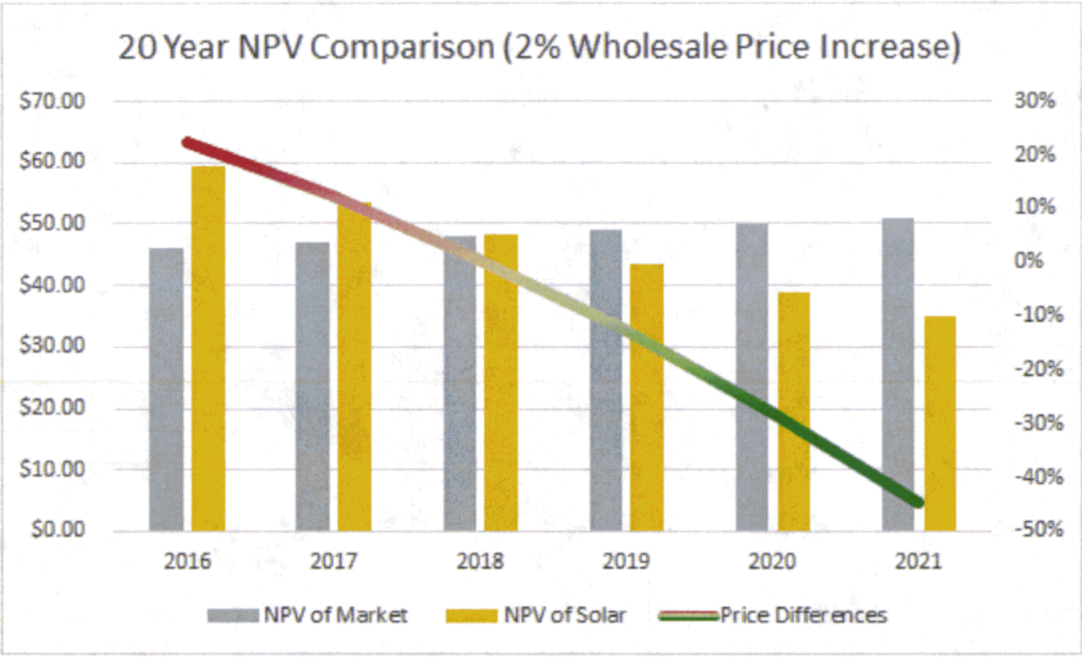
RUCO supports annual targets to track progress but with flexibility. Yearly targets can be overly restrictive and flexibility should be given when prudent to deviate from a yearly target. Banking provisions can also provide annual flexibility. However, expiration dates may need to be added to avoid any excesses.

11. Are there proposals for limiting the cost of REST compliance we should consider?

Focusing on utility scale assets specifically, the Commission could set a cap based on projected above market cost. Ideally, implementation plans submitted by each utility would include a comparison of any proposed utility scale renewable assets with the Market Cost of Comparable Conventional Generation. If the renewable asset costs exceeded the market cost by a certain amount, its procurement would be deferred. For example, if the price of the asset was expected to exceed market costs over its lifetime by 50% or more, resource acquisition would be paused until the following year.

RUCO conducted a high level NPV analysis of the projected cost a new utility scale solar asset with that of Palo Verde spot market wholesale prices to determine the extent of possible above market cost. We modeled four scenarios. 1. Wholesale prices remain at historically low 2016 levels - approximately 2.6 cents/kWh. 2. Wholesale prices decline from these historically low levels at 1% per year. 3. Wholesale prices increase 2% per year. 4. Prices over the next decades match the average historical weighted average price at the Palo Verde spot market from the summer of 2001 to the fall 2016 - 4.4 cents/kWh.

RUCO assumes a fixed 20-year 4 cent/kWh large scale solar asset price in 2016 that decreases for new additions at NREL's projection of 10% per year. RUCO also used a societal discount rate to reflect the fact that ratepayer, not shareholder, money is at risk.



2% Wholesale Price Increase

Install Year	NPV of Market	NPV of Solar	Price Differences
2016	$46.09	$59.51	23%
2017	$47.01	$53.56	12%
2018	$47.95	$48.20	1%
2019	$48.91	$43.38	-13%
2020	$49.89	$39.04	-28%
2021	$50.89	$35.14	-45%

0% Wholesale Price Change

Install Year	NPV of Market	NPV of Solar	Price Differences
2016	$38.68	$59.51	35%
2017	$38.68	$53.56	28%
2018	$38.68	$48.20	20%
2019	$38.68	$43.38	11%
2020	$38.68	$39.04	1%
2021	$38.68	$35.14	-10%

Negative 1% Wholesale Price Decrease

Install Year	NPV of Market	NPV of Solar	Price Differences
2016	$35.56	$59.51	40%
2017	$35.21	$53.56	34%
2018	$34.86	$48.20	28%
2019	$34.51	$43.38	20%
2020	$34.16	$39.04	13%
2021	$33.82	$35.14	4%

Average Wholesale Price vs. Average Solar Price

NPV Average of Market	NPV Average of Solar	Price Differences
$65.46	$46.47	-41% (Savings)

In sum, two out of the four scenarios show utility scale solar saving ratepayers up to 45% by being below conventional market costs. The other low priced wholesale market scenarios show utility scale solar being about 40% above conventional market costs.

12. What value is there in diversity of ownership? Is utility ownership of renewable generation inherently better or worse than third party ownership?

The answer to this question depends on risk and time horizon. Generally speaking, third party PPAs are cheaper in the first 20 years of operation and utility owned resources are cheaper after a typical PPA contract sunsets. For example, if owned by a utility, a solar resource is essentially free after it's depreciated life because there is no fuel and little O&M. But under a third party owned scenario, the developer would still have to be paid some avoided cost rate. Certain flip agreements may be the best deal because they can merge the best of both assuming transaction and compliance costs are kept low. There are also risks factors to consider. A PPA shields ratepayers from under performance or technology failure because payments are only for energy delivered. It should also be understood that there may be operational constraints with a PPA compared to a utility owned resource that can be controlled as the utility sees fit.

For these reasons and others, RUCO believes there should be a blend of ownership models.

This is particularly true for distributed assets that are not competitively procured like PPAs. Retail rate net metering does not allow for non-participants to fully capture the value of declining technology costs, however utility-owned rooftop solar programs would. Therefore, the price will almost always be cheaper for utility owned DG compared to a NEM alternative as found by Staff and cited by the Commission in its recent Decision 75815.

13. Should energy purchased via Power Purchase Agreements or from out of state (through long or short term contracts or through wholesale spot markets) count towards the REST?

Yes, bundled renewable energy contracts (whether short or long term) should count.

14. What is the best way to insure the REST portfolio a utility selects is the least cost way to comply?

As the above example shows, even seemingly simple cost comparisons between third party-owned and utility-owned systems can be subjective and multifaceted. That said, RUCO believes that the following principles will help ensure a least cost portfolio:

1. Regular and broad stakeholder review
2. Balance between resources and ownership models
3. The minimization of arbitrary and confusing rules
4. A level playing field that sends accurate price signals aligned with system needs

A retail sales based standard can be designed to achieve all of this these except item four. The attached whitepaper discusses this issue and proposes a potential solution.

The following questions are specific to particular sections of the REST rules:

R14-2-1801: Are any new definitions needed? Should a definition for storage be added? Can any definitions be removed? Do any definitions need to be changed? Specifically, should A. "Affected utility" be changed such that cooperatives and small utilities are excluded? B. Should "Distributed Generation" (and related definitions) be changed so that it is no longer necessary for the relevant facility to be at a "customer premises?"

With regard to the definition of "Affect utility," RUCO makes no comments as they relate to cooperatives. However, a small utility, such as UNS Electric, has a much different energy portfolio and RUCO does not believe a definition that is a one size fits all is appropriate.

With regard to the definition for "Distributed Generation." in Tucson Electric Power's 2016 Renewable Energy Standard Implementation Plan proceeding, RUCO supported modifying the definition of "Distributed Generation" to include "a concept of allowing renewable energy facilities located within the distribution system, serving residential customers, to count toward the residential REST requirement." RUCO believes the spirit and intent of implementing cost-effective renewable energy should not be held captive by outdated definitions.

With regard to a definition for storage, adding a definition for storage will depend on whether storage becomes part of Article 18.

R14-2-1802: Are there any new types of Renewable Energy Resources that need to be added to this list? Should any of these resources be removed?

RUCO is not aware of any.

R14-2-1803 and 1804: Are Renewable Energy Credits (RECs) the best way to assess compliance? Are there other ways to assess compliance that are more efficient or less burdensome? Are there unintended consequences associated with using RECs'? Should RECs that originate from distributed energy generators not owned by the utility be eligible (or be required) to count towards the utility's REST requirement?

Yes, if the standard is a simple percentage of retail sales and not based on time of delivery, RECs are a good way to establish compliance. For RECs not transferred to the utility by no fault of the system owner, few good options exist for currently operational systems without the potential of double counting. The Commission could transition the DG carve-out to a Non-fuel based carve-out to capture existing systems while still maintaining a 4.5% target for instance. But anything short of a large change like this would not solve the issue for existing systems. Going forward, it is very easy to solve the problem of REC transfer and RUCO has proposed REC transfer in almost every DG related proposal it has ever put forward.

R14-2-1804: Is a goal of 30% renewable generation (by annual kWh) attainable by 2030? What are the consequences for ratepayers from such a goal? (Please distinguish between rate impacts specific to the new goal and rate impacts that are likely to occur whether a new goal is established or not.) If a 30% by 2030 goal is adopted, is it necessary to adopt intermediate goals for each year prior to 2030? Or would it be more efficient to set alternative goals e.g., for every other year or for every fifth year or to base the required adoption rate on demonstrated least cost based planning?

As other states have shown, 30% is attainable and currently at least one of Arizona's IOUs has already planned to be at this goal. RUCO answer to question 11 shows potential pricing impacts. It is impossible to accurately project rate impacts because it is dependent on market costs for energy, resources chosen, their price, and when they are installed. RUCO furnishes the following example for APS covering the incremental addition of compliance from a 15% standard to a 30% standard. This assumes (unrealistically) that APS will meet the entire new standard with incremental solar PV and that an equal amount of solar is installed each year until there are no more installations once the ITC is reduced to 10% in 2022. RUCO is using the 2% yearly wholesale price increase scenario as presented in the answer to question 11 for this analysis. Under these assumptions, an average residential customer would see an 89 cent monthly bill decrease relative to market purchases. Please see below. This does not take into implementation or integration costs like flexible capacity need. Again this is one of the drawbacks to the percentage of sales based RPS we identify in RUCO's whitepaper. Finally, it assumes that generation units offset by this solar do not need cost recovery.

2% Yearly Wholesale Price Increase Case

MWH of incremental Compliance	Install Year		Per Year Cost/(Benefit) Levelized		Impact on Residential bill
4,404,937	2016	$	29,558,211	$	1.00
	2017	$	14,421,133	$	0.49
	2018	$	554,137	$	0.02
	2019	$	(12,174,657)	$	(0.41)
	2020	$	(23,884,039)	$	(0.81)
	2021	$	(34,681,020)	$	(1.17)
		Total cost/(savings)		$	(0.89)

R14-2-1805: Section A indicates that the Distributed Renewable Energy Requirement was intended to "improve system reliability." How has the deployment of distributed resources actually affected reliability?

RUCO defers this question to experts within the utilities.

Is the carve out laid out in Section B still necessary in light of the size of Distributed Energy providers and in light of the current level of distributed generation deployment?

If the carve out was designed to help scale the industry, that has been accomplished. If the carve out was designed to increase reliability, RUCO argues that much more is needed than a carve-out. Targeted deployments visible to system operators, with some dispatchability are required. A broad DG carve-out does not accomplish this in RUCO's opinion.

Is any carve out for particular types of renewables justified?

Depends on goals of the Commission; however, RUCO favors technology neutral policies that utilize market principles. If there are early stage technologies that require development, RUCO recommends support that is limited and has a clear wind down/cut off date.

R14-2-1806: Are the extra credit multipliers discussed here still appropriate and necessary?

RUCO does not believe so but is open to other viewpoints.

R14-2-1807: Is the Manufacturing Partial Credit provision still appropriate and necessary? Has any utility used a Manufacturing Partial Credit since adoption of these rules?

RUCO believes that this provision is outdated and should be removed.

R14-2-1808: Are any changes to the Tariff provisions of the rules necessary or appropriate?

This provision should be updated to reflect the current reality of the process for setting the Tariff and other related charges.

R14-2-1809: Are any changes to the Customer Self-Directed provisions of the rules necessary or appropriate? How many customers are taking advantage of this provision now?

This provision is no longer applicable because utilities no longer provide up-front incentives. Therefore, this provision should be removed.

R14-2-1810: Is the working group envisioned in section 1810 still necessary or appropriate? When was the last time the working group actually met?

RUCO believes that the language of this provision provides for a one-time working group to be established. It is unclear what role this working group played, if any, in establishing the Uniform Credit Purchase Program which was created to encourage "the implementation of Distributed Renewable Energy Resources." Such a workgroup seems outdated and as such this provision should be removed.

R14-2-1812: Are any changes to the Compliance Reporting requirements necessary or appropriate?

Nothing immediately jumps to RUCO's attention. Although it would be convenient to have reports posted on ACC website include Excel files. It would also be helpful to report actual renewable generation on the system in addition to what's reported for compliance (which includes banked credits, etc.).

R14-2-1813: Is it necessary for utilities to file an implementation plan every year? Would every other year (or some other period of time) be sufficient? Is there additional information that should be included in the implementation plans? Is there information that is required now that can be done away with?

RUCO supports yearly filings but also is open to bi-yearly proposals within that yearly context. In other words, a Company could file a two year plan if they so wish and the Commission approves. Absent that action, they would be required to file yearly.

R14-2-1814: Given the nature of cooperatives is it appropriate to subject them to the same requirements as investor owned utilities? Should the smaller and larger cooperative utilities be treated the same? Are there small utilities other than cooperatives that should be exempted in whole or in part from the REST rules?

No comment as this goes beyond RUCO's statutorily defined mandate.

R14-2-1815: Are any changes to the Enforcement and Penalties section necessary or appropriate (other than changes needed to conform them to any other changes made to the REST rules)?

RUCO sees no compelling reason to change these provisions. Some states form what is called "alternative compliance payments". If a utility is short on compliance, a price is subscribed to each kWh of the shortfall. The funds raised by this can go to certain rebates and programs to help meet compliance.

R14-2-1816: Are any changes to the Waiver section necessary or appropriate?

Not if RUCO's suggestions around the DG carve-out are followed.

RESPECTFULLY SUBMITTED this 30th day of November, 2016.

Daniel W. Pozefsky
Chief Counsel

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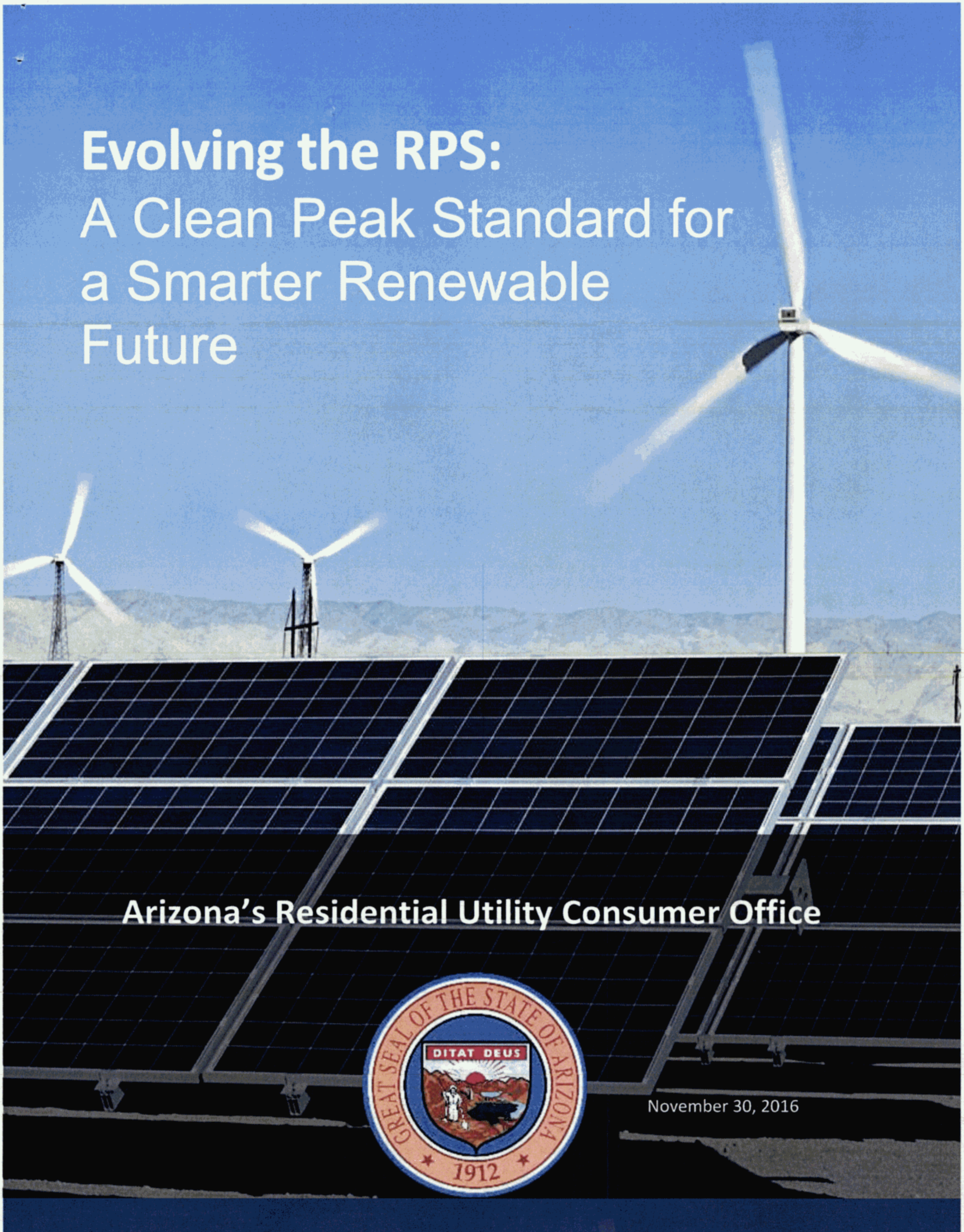
EXHIBIT 1



Evolving the RPS:
A Clean Peak Standard for a Smarter Renewable Future

Arizona's Residential Utility Consumer Office

November 30, 2016

Evolving the RPS: A Clean Peak Standard for a Smarter Renewable Future

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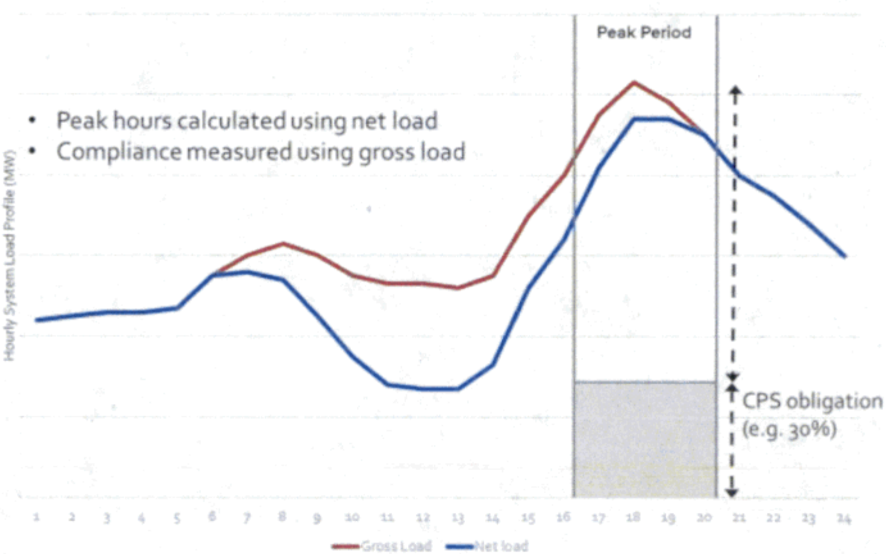
Executive Summary

Renewable Portfolio Standards (RPS) have been fundamental to jump-starting the renewable energy (RE) industry, accounting for over 60% of the growth in RE generation since 2000. However, the simple MWh-based approach used by traditional RPS policies does not differentiate between each renewable MWh based on its value to the grid or for reducing fuel consumption. Already some states are experiencing challenges as renewable energy production during certain times is beginning to provide diminished value in terms of reduced fuel consumption or capacity contribution. As states continue to achieve their RPS goals and reach increasingly higher levels of RE penetration, new approaches will likely be needed to guard against diminishing returns of a simple MWh based approach.

As a way of encouraging clean energy resources to provide all the necessary attributes of a reliable power system, we propose building upon the traditional RPS framework by adding one or more new supplemental components that would work in parallel with the foundational MWh-based retail sales component. The first and foremost of these new components would be the Clean Peak Standard (CPS). The CPS builds upon the RPS construct, by adding a new dimension whereby a certain percent of energy delivered to customers *during peak load hours* must be derived from clean energy sources. For example, a 30% CPS would mean that 30% of MWh delivered to customers during a predetermined peak period would need to come from qualifying clean peak resources.

Illustration of Clean Peak Standard (CPS)



Many additional design features can be included in the implementation of the CPS such as tradable compliance credits, locational adders, multi-part peak periods, and periodic updates to continually align new investments with system needs. Ultimately, if successful, the proposed RPS framework can help to achieve clean energy resource procurement that is aligned with the full suite of grid services that electric power system operators need to supply.

Background and Context

Renewable Portfolio Standards: A Strong Start Towards a Clean Energy Future

Twenty-nine states and Washington D.C. have adopted renewable portfolio standards (RPS), which today apply to 55% of electric sales in the U.S.[1] These policies have been fundamental to jump-starting the renewable energy (RE) industry, accounting for over 60% of the growth in RE generation since 2000.[2] While each state has its own unique variations on an RPS, all state policies generally require retail electric providers to supply a minimum percentage of their retail load (in MWh) from renewable resources. Frequently, states use Renewable Energy Certificates (RECs) both to track compliance and to create a marketplace for renewable energy. The success of RPS policies stems, in part, from the simplicity of this framework. The retail sales requirement and associated REC construct creates a degree of certainty and transparency on which prospective developers and installers can rely to assess the value of renewable energy.

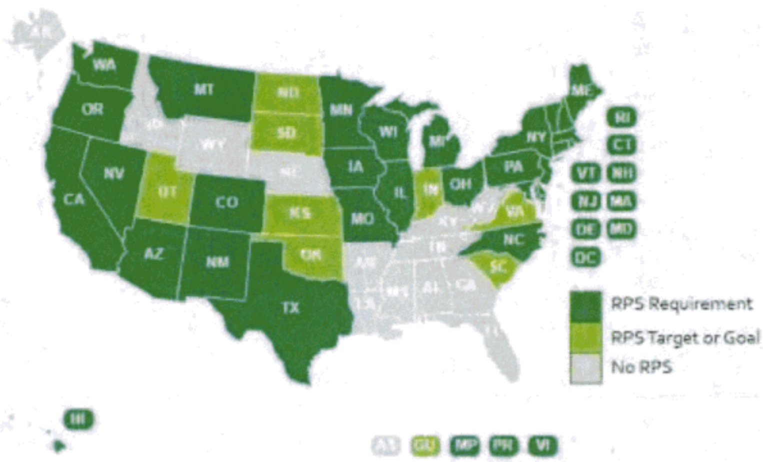


Figure 1. States with RPS Policies (adapted from www.ncsl.org)

However, as states achieve their goals and reach increasingly higher levels of RE penetration, many are beginning to decide what policies should come next. Some states have already doubled down on the traditional approach, simply expanding their retail sales targets. Others are considering more targeted procurement methods that focus on specific resources, such as solar. As more states move towards the next chapter of clean energy policies, it will be increasingly important to consider benefits and drawbacks of the traditional RPS approach and explore improvements that will maximize public policy benefits.

Potential Pitfalls in Expanding Traditional RPS Frameworks

While each state has its own reasons for advancing RPS policies, many have done so primarily to reduce overall fuel consumption, which is associated with price volatility, fuel dependency, and other externalities. In this context, an energy-centric standard based on MWh sales is a sensible approach. Moreover, a MWh-based component will continue to be an important part of maintaining these policy objectives. However, a simple MWh-based standard lacks specific

[1] Lawrence Berkeley National Lab, U.S. Renewables Portfolio Standards: 2016 Annual Status Report (April 2016)
[2] *Ibid.*

market signals that differentiate between the value of each renewable MWh based on the time when it is produced. Discrepancies in this value could lead to RPS compliance being met by a set of MWhs with very unequal grid-related benefits and unequal fuel-related benefits, both of which are described below.

Unequal Grid-Related Benefits

From an electric provider's standpoint, the total MWh of energy supplied is only one component of what's needed to ensure reliable electric service. The system must also have sufficient MW of capacity to meet peak demand. Beyond energy and capacity, there are other types of essential grid services that a supplier's portfolio of resources must provide, such as frequency regulation, load following, and spinning reserves. Providing capacity during peak hours is a time-specific grid service that is not well matched with an indiscriminate MWh-based standard. A traditional RPS would not necessarily encourage clean energy resources to provide these services; in the absence of a clear market signal, they are instead likely to be provided by conventional resources (often operating in standby mode), thereby prolonging fuel dependency and potentially increasing costs for customers. Moreover, the MWh-based standard may not adequately reward the enhanced value of resources that can deliver clean energy more flexibly and adapt to the grid's needs. In some states, such as California, high renewable energy penetration has also led to new challenges, in large part due to the changing set of grid services needed to accommodate high penetrations of solar PV.

Symptoms of increasing renewable penetration in California[3]

- Shorter, steeper ramping events that require CAISO to quickly bring capacity online or offline
- Oversupply and curtailment during midday hours of peak renewable generation and decreased load
- Reduction in frequency response due to lack of available flexible resources

Unequal Fuel-Related Benefits

From the perspective of reducing fuel consumption and reducing externalities, the incremental impact of renewable energy can also be very time-specific. In reality, this benefit depends largely on the marginal generation unit at the time of production. Reductions in fuel consumption and environmental impacts (e.g. emissions of criteria air pollutants, greenhouse gas emissions, etc.) due to renewable energy can vary over the course of the day and by season. As renewable penetration increases, this benefit could even fall to zero at certain times. For example, during some hours there may be overgeneration of renewable resources causing curtailment. At other times, the marginal resource may not be a non-fuel based resource (e.g. hydro). Figure 2 and Figure 3 illustrate the growing overgeneration problem in California and Hawaii due to recent increases in the penetration of solar PV resources.

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[3] Adapted from CAISO Flexible Resources Fast Facts (PDF) (2016), https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

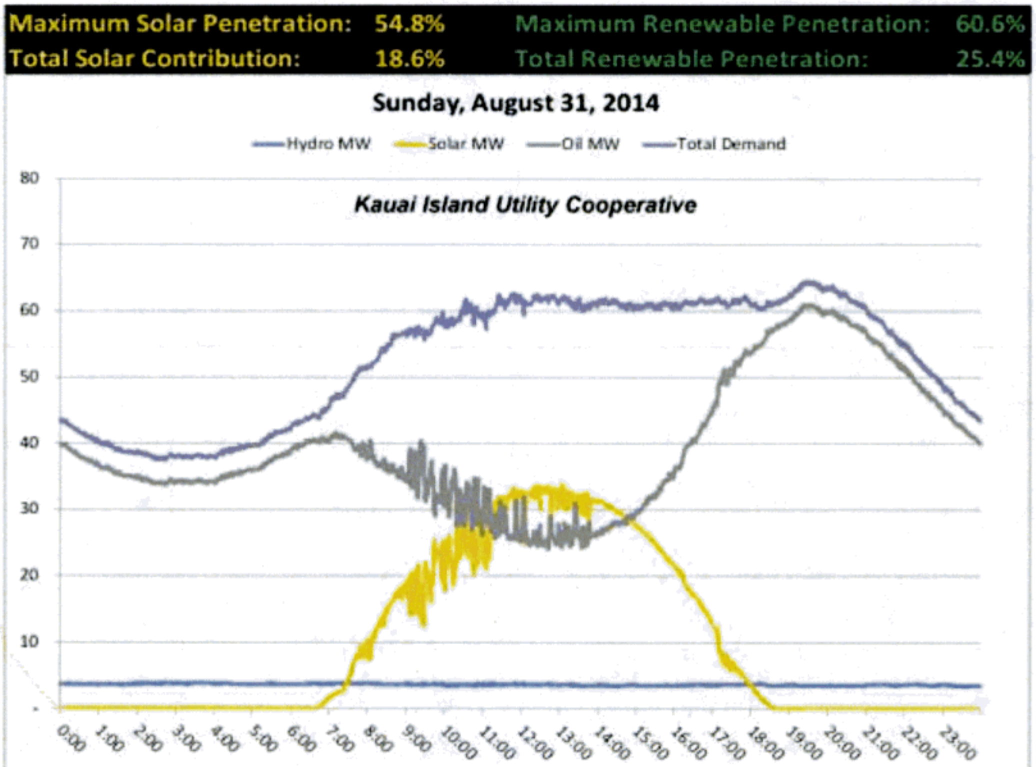

Figure 2. Overgeneration in Kauai, Hawaii (energy.gov)

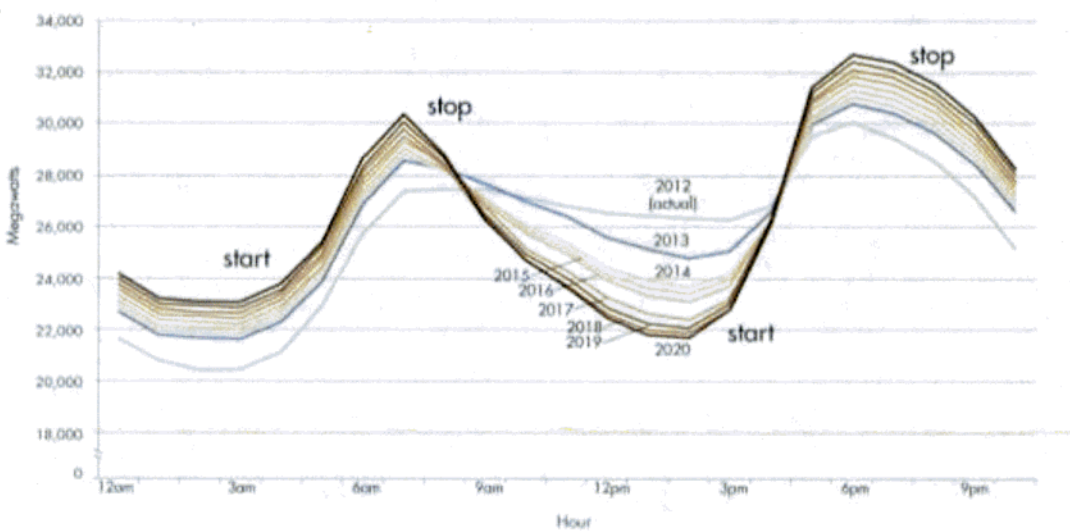

Figure 3. California Net Load for January 11, 2012 – 2020 (caiso.com)

Over the long run, indiscriminate procurement of renewable resources based solely on annual MWh of production could exacerbate some of these discrepancies while introducing new challenges. For example, in the Southwest, the addition of solar PV resources could have diminishing returns in reducing fuel consumption if a significant portion of PV generation is already being curtailed due to overgeneration. Meanwhile, solar PV's contribution towards peak demand will also be diminished as net load shifts into evening hours.

In fact, a 2014 CAISO study examined a scenario in which California increased its RPS from 33% to 40%. The results indicated that despite a 7% increase in the standard, greenhouse gas emissions (GHGs) were only reduced by 2% in California (see Figure 4).[4] Further, the study predicted peak demand related capacity shortfalls and over 13 GW of renewable curtailment in one spring month.

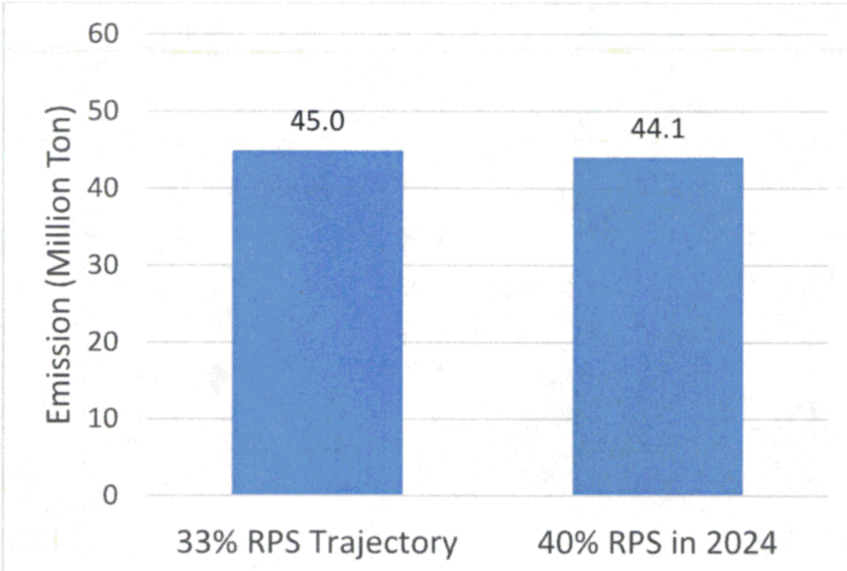

Figure 4. Reduced incremental GHG savings with increased California RPS (adapted from CAISO 2014 LTPP System Flexibility Study)

These results are consistent with findings from another study exploring a 50% RPS for California, which demonstrated that as more renewables are added, the marginal fossil generator displaced is increasingly efficient. This means that increasing the RPS would result in fewer greenhouse gas emissions savings per MWh of RPS target.[5] The 50% study further concluded that due to overgeneration, "more renewable resources must be procured than would be the case if all renewable resource output could be accommodated by the grid." Under an alternate case in which RE procurement was better matched with the grid's capabilities and needs, rate impacts of achieving the RPS were reduced by 10-39%.[6]

Thus, as RPS policies are scaled up in the future, the incremental benefits of complying with an RPS could become dampened under a traditional approach. A more sophisticated approach is needed to help target renewable energy procurement towards incremental clean energy resources that yield the greatest value to the grid and to customers.

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[4] CAISO 2014 LTPP System Flexibility Study, Slide 52
https://www.caiso.com/Documents/Presentation_2014LTPPSystemFlexibilityStudy_SHcall.pdf

[5] Energy and Environmental Economics, Investigating a Higher Renewables Portfolio Standard in California (PDF) (January 2014), p 142.

[6] Ibid, p 158.

Finally, another potential pitfall of traditional RPS policies is that market activity can slow down or stop abruptly once compliance is achieved. This is problematic since it tends to create boom and bust cycles within the industry that may not be sustainable over the long term. Different policy designs could be developed to help extend market signals and direct appropriate investment beyond the immediate targets.

A New Approach: RPS 2.0

Introducing a Multi-Component Clean Energy Standard

Electric power system operators must plan the for the grid to meet a variety of needs. To better capture the multiple attributes of a properly planned system, and to ensure clean energy resources can participate in providing all of them, we propose building upon the traditional RPS framework by adding one or more new building block components that would work in parallel as a supplement to the foundational MWh-based retail sales component. The full suite of RPS 2.0 components can be summarized as follows, and as illustrated in Figure 5:

- Block 1 (foundation) – Traditional MWh-based Renewable Portfolio Standard
- Block 2 (new) – Clean Peak Standard
- Additional Blocks (new, optional) – Example: Clean Flex Capacity Standard

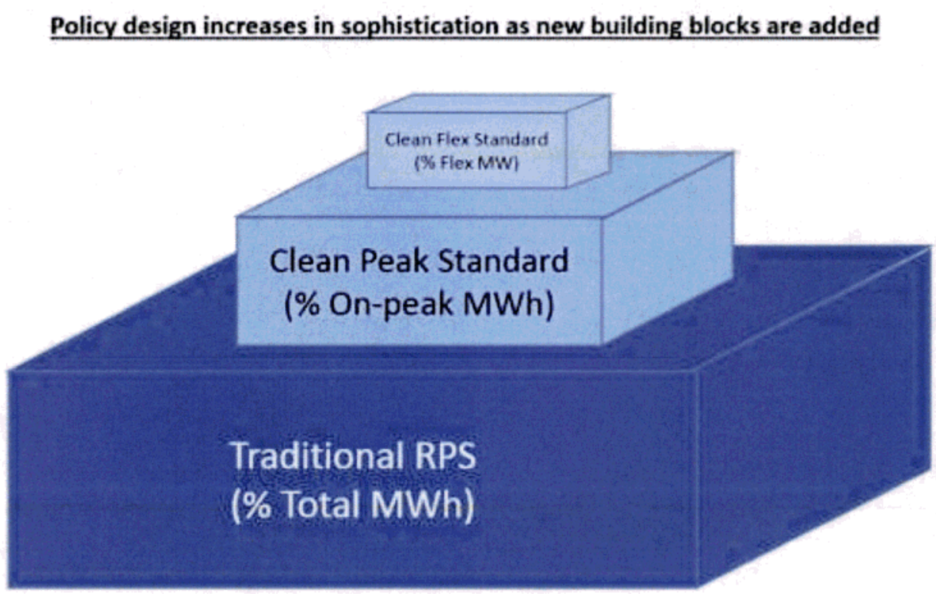

Figure 5. Conceptual Building Blocks of the RPS 2.0 Framework

Thus, the foundation would be comprised of the traditional MWh-based RPS. Meanwhile, a second, complementary building block would introduce a capacity-based standard that would focus on peak demand needs. This component is designed to encourage clean energy resources to provide capacity during peak demand hours. Under this framework, a minimum percentage of energy dispatched during a predefined peak window (e.g. 4 hours) must come from qualifying clean energy resources. The following sections of this paper provide a more detailed description of how the Clean Peak Standard could be implemented.

While the peak demand attribute (Block 2) is perhaps most readily included in the multi-component RPS, it would be possible to add other grid services that are identified and evaluated for system planning. For example, a new component could be added to encourage clean energy resources to provide flexible capacity during high flexibility need hours, if this was determined to be an important system constraint from a planning perspective.

As new blocks are added, the policy design increases in sophistication as it becomes more closely tailored to system needs. The overarching intent of this general framework is to better align clean energy procurement with the full suite of grid services that energy providers need to supply. While we acknowledge that most jurisdictions have not yet reached penetration levels where this is an urgent problem (with possible exceptions of Hawaii and California), we anticipate that this will increasingly become an issue over the coming years. Renewable penetration is poised to increase due to both RPS procurement and increased economic competitiveness of renewable resources. In anticipation of these trends, the table below summarizes some of the grid services that could be subject to a corresponding standard.

Table 1. Essential grid services and corresponding clean energy standards

Grid Services Traditionally Provided by Conventional Resources	Corresponding Clean Energy Standard	Measurement Unit
Energy	Renewable Portfolio Standard	MWh
Capacity	Clean Peak Standard	On-Peak MWh
Load Following/Flexible Capacity	Clean Flex Standard	MW
Regulating Reserves	Clean Regulation Standard	MW
Spinning/Non-Spinning Reserves	Clean Reserve Standard	MW

Whatever components are ultimately included, it is vital that each additional component not be viewed as a substitute for the traditional MWh-based standard, but rather as parallel complementary policies. This is necessary to ensure that no component is pursued at the expense of other components. However, while each reflects a discrete system planning constraint, a single resource can be used to simultaneously contribute towards each component. For example, generation that counts towards Component 1 (i.e. overall MWh) could also contribute to Component 2 (i.e. peak-coincident generation).

Clean Peak Standard (CPS) – Detailed Overview

Under a traditional RPS, load serving entities (LSE) are required to ensure that a certain percentage of energy delivered to their customers (typically measured as a percentage of retail sales) is derived from renewable resources. The Clean Peak Standard builds upon this construct, by adding a new dimension whereby a certain percent of energy delivered to customers *during peak load hours* must also be derived from clean energy sources. For example, suppose that 480 hours out of 8760 in a single year (or ~5%) are initially designated to represent the times of peak load. A 30% CPS would mean that 30% of MWh delivered to customers during those 480 hours would need to come from qualifying clean peak resources. Ideally, the standard would also be able to respond dynamically to changes in loads and resources that alter the system needs (e.g.

the "duck curve"), thereby directing investment towards clean resources that provide the greatest value. To accomplish this, we envision the peak period for the CPS would be established based on net load (i.e. gross load minus renewables), which is assumed to be changing over time, while compliance would be based on gross load.

Qualifying Clean Peak Resources

Several types of resources could potentially qualify as clean peak resources and therefore be eligible to contribute towards the standard. These might include:

- Renewable Resources (on-peak production only)
- Energy Storage (if charged by eligible clean peak resources)
- Demand Management Measures (based on measured savings)

Some of these require special consideration. Since storage generates no new energy on the system, its contribution to the Clean Peak Standard would need to be adjusted to properly reflect the amount of clean energy used during charging. Failure to do this could lead to a result that is counterproductive to the original intent of the RPS (for example, a storage unit could increase overall fuel consumption if charged during a period when natural gas was on the margin due to its round-trip losses). For storage charged directly by renewable resources (e.g. behind the meter solar plus storage) no adjustment factor would be needed. For grid-charged storage, the adjustment factor would ideally be based on the fraction of grid energy coming from renewable resources (other possible adjustment factors could be considered based on measures such as systemic load factor). For the sake of simplicity, this could initially be established as an annual average value, but could be made more granular and precise if desired. Such an approach could allow seasonal or even hourly average value of renewable penetration to determine the adjustment factor. Additionally, as another option for developers, it might be reasonable to allow storage resources to contract with remote renewables to provide "virtual charging." Under this construct, a storage resource's output could qualify if its charging coincided temporally with the output of the renewable resource that it contracts to virtually charge it. This would require the charging resource to transfer their RECs to the storage resource.

Regarding demand management measures, many states already have robust policies in place that target the provision of peak demand savings from through demand management measures. Additionally, it is worth recognizing that any peak demand savings achieved through existing demand management programs would automatically contribute towards compliance toward the clean peak standard due to its effect on gross load, even if the measure is not directly awarded a credit for doing so. From this standpoint, it may not be necessary to include demand management in the CPS construct. However, to the extent that demand management measures are included, it might be worth focusing on measures that either: a) are incremental to existing demand management programs, or b) include some form of direct metering or other data source to verify peak savings activity,[7] or c) have high peak coincidence factors (e.g. HVAC units).

Peak Demand Window

The CPS would be based upon a predetermined set of hours that are aligned to peak demand on the grid. While it is impossible to predict in advance exactly which hour will be the peak in any given year, it is possible to determine a subset of hours that anticipates when peak is likely to occur, and during which clean energy output has significant capacity value. For simplicity's sake,

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[7] In theory, many demand side management measures would qualify under this category by using standard practice measurement and verification ("M&V") protocols. These protocols routinely measure coincident peak demand savings achieved and such measurements are increasingly accurate due to the deployment of AMI infrastructure.

and to send a clear market signal, we recommend that this subset could be represented as a 4-hour seasonal peak demand window (similar to how many jurisdictions approach resource adequacy). This could be constructed as follows:

- Determine the 4 months out of the year that have historically exhibited the highest peak demand (e.g. June through Sept)
- Determine the peak load hour during each of these months over the last 5 years. (e.g. 5-6pm in August 2015)
- Calculate the median hour of peak demand from these 20 months.
- Establish a 4-hour peak window based on the median hour calculated above. The window would cover 1-2 hours prior to and 1-2 hours following the median. (e.g. 4-8pm for each day in June-Sept)
- 4 hours/day * 30 days/month * 4 months/year = 480 hours/year

Clean Capacity Credit

Under a traditional RPS, renewable resources are typically able to generate renewable energy credits (RECs) in all 8,760 hours of the year, regardless of when renewable energy production occurs. These RECs are in turn purchased by or transferred to load serving entities to demonstrate compliance. Under the proposed Clean Peak Standard, compliance would be determined based on the amount of clean energy dispatched during a certain subset of hours aligned with the system peak load. If clean energy is dispatched during the peak hour window, it would able to generate a Clean Capacity Credit (CCC), which is equivalent to 1 MWh of energy generated during the peak period. CCCs would function as tradeable commodities, similar in nature to RECs. These credits could then be retired to meet the LSE's CPS compliance obligation.

Table 2. Comparison of key implementation details for a Traditional RPS and Hypothetical Clean Peak Standard

Parameter	Traditional RPS	Clean Peak Standard
Compliance Timeframe (during which RECs/CCCs can be generated)	8760 hours	480 hours (peak)
Peak Load	2000 MW	2000 MW
Load Factor (during compliance timeframe)	50%	90%
Total Energy Delivered (during compliance timeframe)	8,760 GWh	864 GWh
Standard	30%	30%
Compliance Obligation	2,628,000 RECs	259,200 CCCs

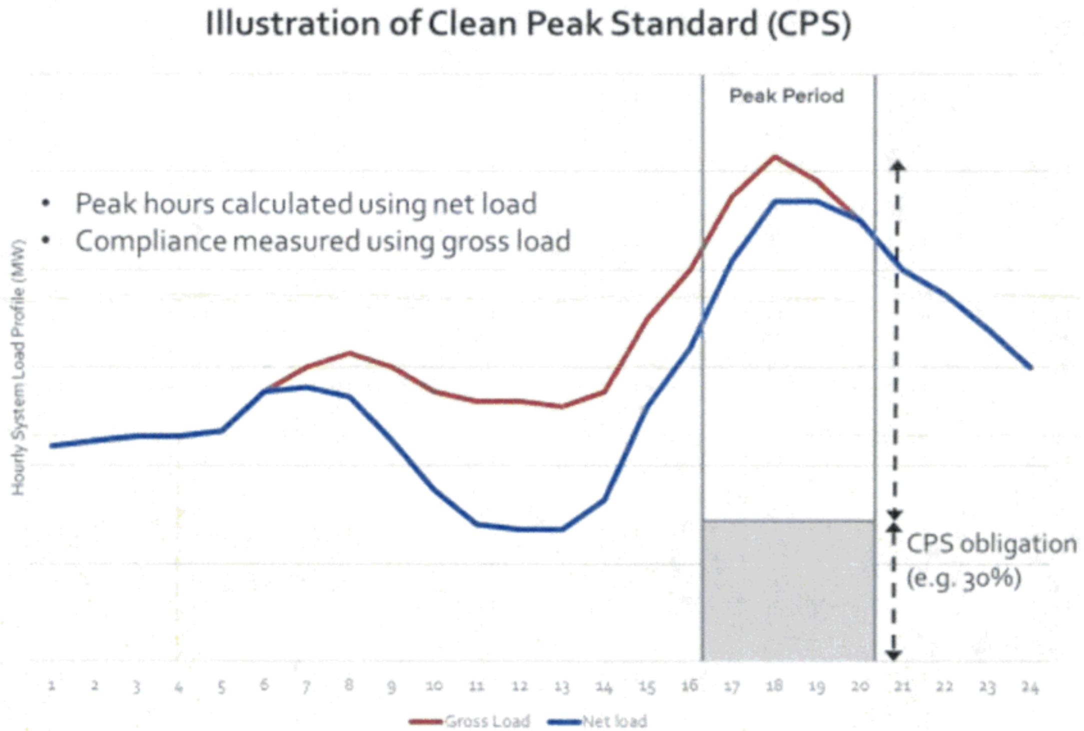

Figure 6. Illustration of the basic components of the Clean Peak Standard (CPS). In this case, the gray rectangle depicts the CPS obligation, which corresponds to a portion of energy needed to meet load during the Peak Period.

Clean Capacity Credits (CCCs) would be awarded to resources based on their ability to produce energy during each period. Since this is intended to reflect capacity available to support grid services, the credit could be based upon the lowest level of production during the period (as measured over each hour's averaged production).

Locational multiplier

Resources that are connected directly to the distribution system may also be eligible for an additional location-based credit multiplier. This reflects the fact that the resource's capacity is more valuable due to its proximity to load, particularly in transmission-constrained areas within certain load pocket areas. In these load pocket areas, capacity is more valuable from a system planning perspective, and often more difficult to procure due to NIMBY issues and more stringent air and land permitting requirements. At a bare minimum, the locational multiplier for a distributed resource should account for line-losses that typically occur for supply-side resources generating during the peak window. To the extent that the resource also helps to avoid "out of merit" dispatch within the load pocket, additional locational attributes could also be considered.

Creating multiple peak periods

One potential drawback in the simplistic design described thus far is the tendency for the output of some renewable resources (e.g. solar PV) to decline substantially within the peak window itself. In this case, the resource provides a more limited capacity value than one that produces energy across all four hours. However, production even in the first portion of the peak window still has some value. To address this issue and to provide a distinct market signal for resources that produce during the latter portion of the window, we suggest that the CPS compliance obligation be subdivided into two segments – each corresponding to a distinct 2-hour block of the 4-hour peak window. Under our current example, the LSE must obtain an approximate total of 260,000 CCCs. If the peak window was established from 4-8pm, the LSE would need to obtain 130,000 CCCs for Period 1 (4-6pm) and 130,000 CCCs for Period 2 (6-8pm). For example, in the diagram below (Figure 7), during Period 1 a solar PV system produces at >1 MW in hour 17, and at 1 MW in hour 18. Thus it would receive 1 MW x 2 hours (2 MWh total) worth of CCCs. During Period 2, the same facility receives no CCCs since its production falls to zero in hour 20.

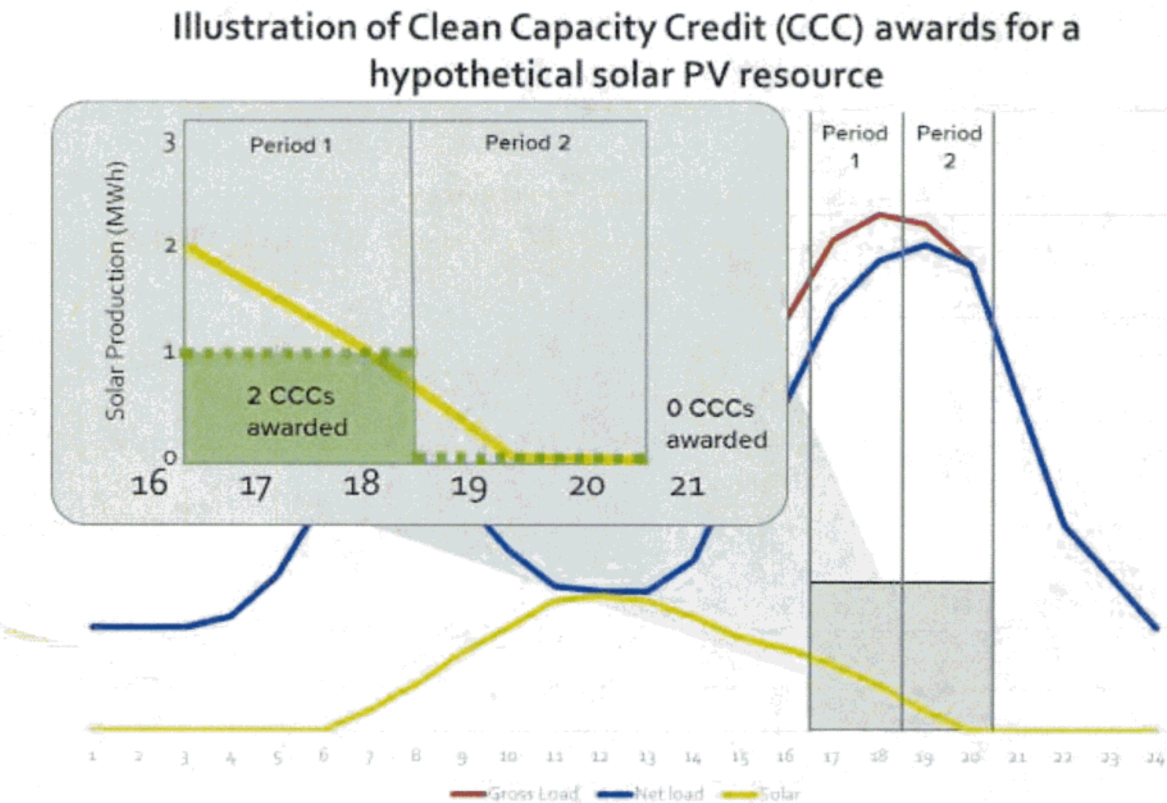

Figure 7. Hypothetical illustration of how Clean Capacity Credits would be awarded to a solar PV resource based on its production during a multi-part Peak Period.

Adjusting the peak period over time

As new resources are added to the system, both to meet the CPS and for other reasons, it is likely that the peak net load hour (and the corresponding system needs) will change over time. As this occurs, additional compliance periods can be added to reflect these new conditions (see Figure 8). This also creates a sustainable pathway for the CPS to evolve and continue to attract appropriate new resource investments over time. By automatically extending to include new peak period targets, the CPS also helps to avoid one of the pitfalls of the traditional RPS, in which market activity can stop abruptly once compliance is achieved.

Ideally, the net and gross loads on the system would be reassessed on a regular interval (i.e. bi-annually) to determine if needs have shifted significantly enough to warrant additional peak periods. Once, a period has been established, it would not be removed for a certain length of time (e.g. 10 years), to help provide prospective developers with a degree of certainty that CCCs would retain value as a revenue stream.

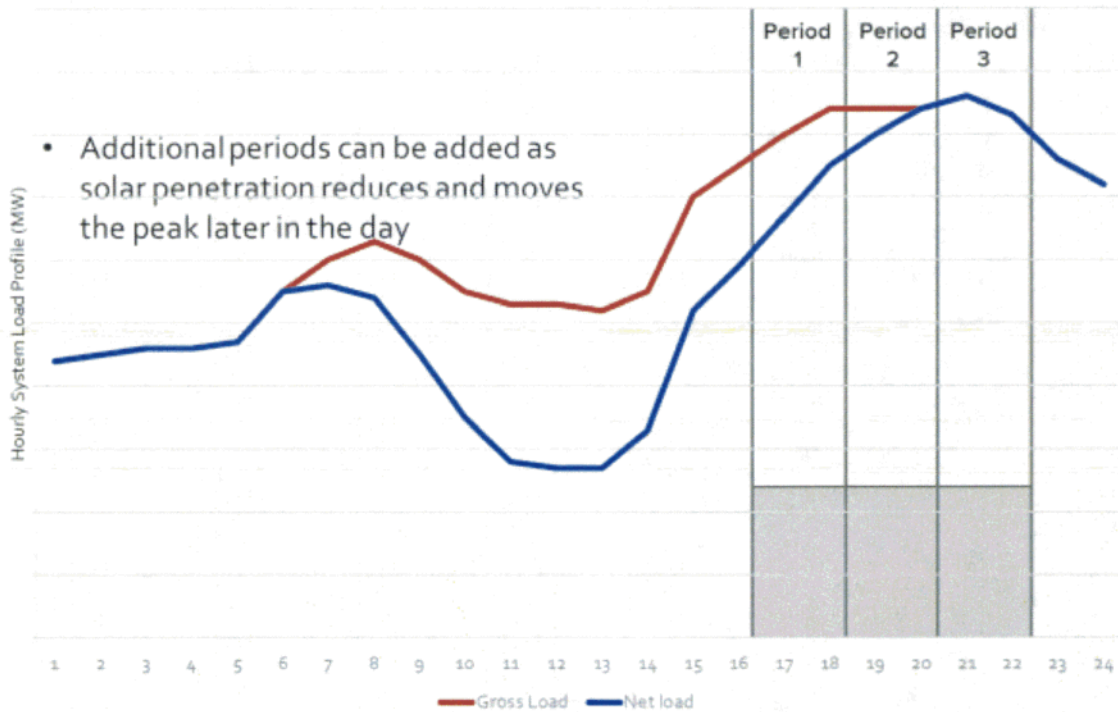

Figure 8. As the net load evolves, new Peak Periods can be continually added to keep the CPS up to date with system needs.

Containing Costs of Resource Procurement

Part of the goal of the clean peak standard is to ensure that customers are benefiting from clean energy resources that also help to keep system costs low. If resources are procured by a load serving entity on behalf of its customers as part of a clean peak portfolio, ideally there would be a screening process to evaluate cost-effectiveness of each resource, that would function as a form of consumer protection.

To accomplish this, one option would be to compare the net present value ("NPV") cost of an eligible resource per CCC produced (i.e. $/MWh, levelized) to the NPV of an alternative peaking resource per MWh of equivalent peak power produced. NPV in this case would reflect both the capital and ongoing operating costs, as well as any costs or benefits realized outside of the peak window (e.g. energy generated or consumed, ancillary services provided, etc.).

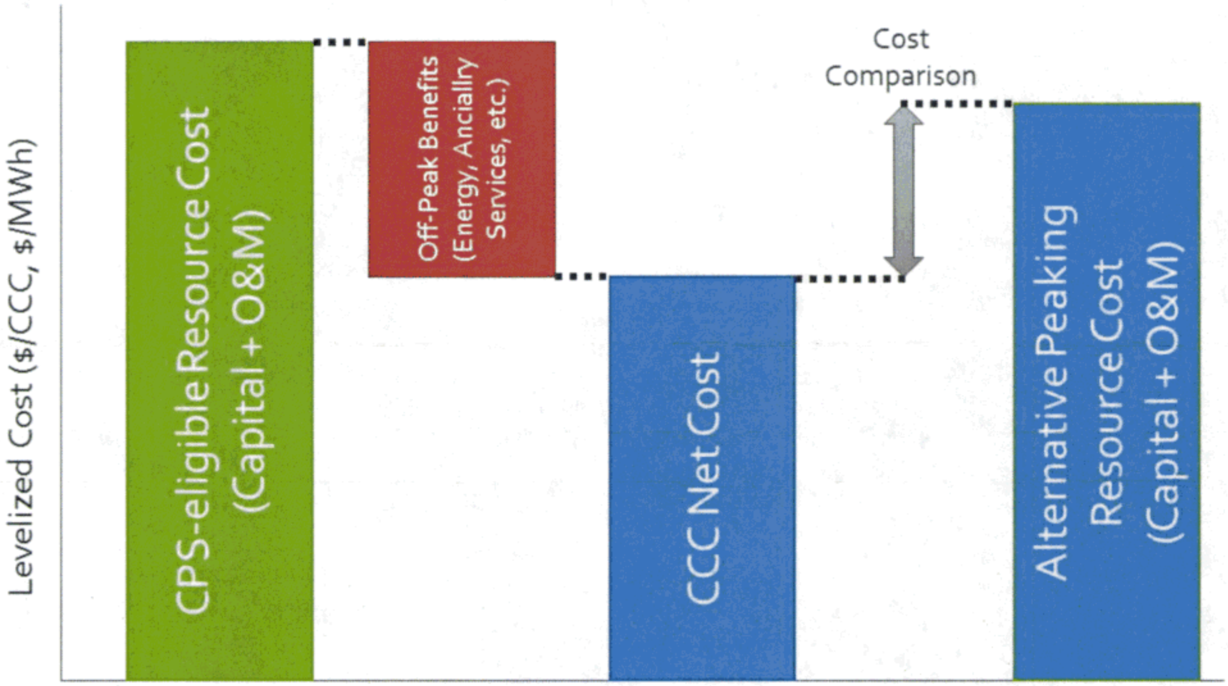

Figure 9. Illustration of a cost comparison between a CPS-eligible resource and a conventional alternative

For behind-the-meter resources, some accounting for lost revenues due to retail customer bill savings may also be appropriate.

As an example, the alternative resource to be considered could be a modified version of a natural gas combustion turbine that provides peak generation capability (e.g. a LMS 100 unit). Ideally, the per unit cost of CCCs procured to meet the standard would be less than or equal to the alternative. If insufficient CCCs are procured to meet the compliance obligation, an Alternative Compliance Payment (ACP) could be established similar to some states' current RPS approach, which would be used to provide incentive funding for CPS-eligible resources. If there are CCCs included in the CPS portfolio that exceed the alternative benchmark, other compelling reasons should be presented to justify full cost recovery by the load serving entity.

Conclusion

As states continue to achieve higher penetrations of renewable energy, some have begun to grapple with new challenges in terms of maximizing the benefits reducing the costs of additional RE procurement. The advanced RPS approach presented in this paper can help to better target procurement towards the needs of the grid and provide a sustainable path for renewable energy deployment into the foreseeable future. A cornerstone of this new approach is the introduction of the Clean Peak Standard which will help to encourage clean energy resources that generate energy during peak hours, when it is needed most. Additional components and implementation details can be added over time to create a more sophisticated RPS that is more aligned with the true needs of the grid.

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